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Memorandum

To: Jim Davies, P.E.
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From: Scott Helm, P.G. 
Geotechnical Manager - Butte District

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District Geotechnical Engineer - Butte District

Date: April 28, 2010

Subject: NH-F 8-4(16)78
Townsend – South and Townsend – South Passing Lanes
CN: 1420000 and 1420001
Geotechnical Engineering – Alignment (Activity 464) Report
Addendum #2: Revisions based on revised letting and Project Scope and Limits

The Geotechnical Section has completed its analysis for alignment and minor structure features for the subject project. This report is being issued as an addendum to address and reiterate design recommendations from the original report, dated June 22, 2007 and Addendum #1, dated August 24, 2007.

Due to issues in the ROW procurement process, a decision has been made to let Townsend – South Passing Lanes (CN 1420001) to contract prior to the Townsend – South project (CN 1420000). Also the northern project limits for the Townsend – South Passing Lanes will be revised to accommodate time critical design aspects of the original Townsend – South project.

Location

Both projects are located on US 287 in Broadwater County, in Township 6 North, Range 2 East, Sections 5, 6, 8, 16, 17, 21, 27, 28, and 34 and Township 5 North, Range 2 East, Sections 3 and 10. The original project limits were station 24+60 (RP 78.1) to station 156+60 (RP 86.3).

Based on the PIH Report, the Townsend – South project limits were from RP 78.1 to RP 82.5, with the split being located at approximately station 93+60 and the connection to

the PTW extending to approximately station 99+60. The Townsend – South Passing Lanes project was to begin at RP 82.5 and end at RP 86.3.

Based on the most recent information, the new proposed split for these projects is approximately station 86+00.

Intent

It is our understanding that the intent of these projects is to reconstruct this portion of US 287 to current road design standards. The work will include a horizontal alignment shift to the east of the current PTW throughout most of the project. Minor changes to the vertical alignment will be made to address drainage facilities, structures, and to improve stopping sight distances as necessary. The design speed for this project is 110 km/h. Several passing lanes are also proposed for the projects. The remainder of this addendum provides information specifically relating the Townsend – South Passing Lanes portion of this project. No Synopsis or discussion of the Areal Geology and Field Investigation will be provided with this addendum. The original 464 report and Addendum #1 may be referenced for details regarding this information.

Revised Design Recommendations

Embankment Foundations

Embankment Foundation Treatment is recommended, on the **Townsend – South Passing Lanes** project, for the following areas due to the prevalence of soils with poor support characteristics, shallow groundwater levels, high liquidity indices, and other factors indicative of unsuitable near surface embankment foundation support:

- 86+60 to 87+90 Left

For all Embankment Foundation Treatment areas, begin the treatment at the bottom of the PTW slope and extend perpendicular to within two meters of the toe of the proposed embankment. Extend geotextile up the existing slope one meter as measured on the slope face. Bench existing slopes in accordance with Section 203.03.2 C.

We recommend Modified Embankment Foundation Treatment, for the **Townsend – South Passing Lanes** project, in the following areas due to the prevalence soils with poor support characteristics, high organic contents, surface or standing water/ponds, high liquidity indices, and other factors indicative of unsuitable embankment foundation support.

- 87+90 to 92+20, Left
- 92+20 to 98+90, Left

For all Modified Embankment Foundation Treatment areas, begin by placing 1.2 meters of Rock Fill at the bottom of the PTW slope and extend perpendicular to the toe of the proposed embankment. Place 150mm of Special Borrow, as cushion material, over the Rock Fill. Place geotextile, starting one meter up the existing slope (as measured on the slope face) and extend perpendicular to with 0.5 meters of the proposed embankment slope. Finally, place Special Borrow up to the subgrade elevation. Special Provisions for Embankment Foundation Treatment, Modified Embankment Foundation Treatment, Special Borrow, and Rock Fill are attached.

Embankment Foundation Settlement

Proposed embankment foundation areas were evaluated for total settlement. The estimated amount and estimated time for 90% consolidation has previously been detailed in our original 464 report and Addendum #1 and will not be reproduced with this addendum. However, discussion regarding differential settlement, potential pavement distress, and monitoring during construction is provided below.

It should be noted that all of the estimated settlement could be realized as differential settlement between the existing PTW (or areas covered by the existing PTW) and the proposed new embankments. This differential settlement may cause distress in the paving section between the portion of the existing embankment and the newly constructed embankment, such as excessive longitudinal and transverse cracking, which can lead to premature pavement failure. Premature pavement failure typically manifests itself in the form of longitudinal, transverse, and alligator cracking forming over several years. This potential pavement distress is inherent with this type of construction (offset new embankments with respect to existing PTW embankments) and there is generally no feasible or cost effective method to quickly mitigate the causal differential settlement. The estimated settlement will also affect proposed culverts on the project.

Because of the time required for the majority of consolidation to occur and the potential for large differential settlement, we strongly recommend that the proposed embankments **(for the Townsend – South Passing Lanes project, specifically from stations 86+60 to 98+90)** be constructed up to the subgrade elevation and then be allowed to remain for a minimum of six months to allow the maximum amount of settlement to occur prior to construction to the final subgrade elevation. In addition, we strongly recommend a settlement monitoring program to evaluate (immediately after initial construction and during embankment settlement time) to determine when the rate of settlement has slowed to the point that any remaining settlement will not be detrimental to the stability of the paving section.

This monitoring program is normally accomplished by the use of settlement plates or other Geotechnical instrumentation. However, in the interest of reducing overall project costs, an alternative consisting of simple surveys of embankment top elevations will be utilized after initial embankment construction, to collect the data necessary to evaluate settlement rates. This monitoring will be done by MDT forces.

Proposed initial survey requirements will be to monitor each of the points twice weekly for the first month, weekly the following two months, and monthly thereafter until either six months has passed or it has been determined that the majority of settlement has occurred.

The original blue sheet plans for Townsend – South (CN 1420000) contain a “Construction Settlement Monitoring” note on Sheet 4. This note needs to be added to the revised plans for Townsend – South Passing Lanes, with the station range changed to 86+60 to 98+90.

Embankment Slopes

See our original 464 report and Addendum #1 for additional details.

Culvert Foundation Treatment Areas

We recommend Culvert Foundation Treatment, consisting of 0.6m of subexcavation, geotextile, and foundation material, at the following locations:

Townsend – South Passing Lanes (all stations are approximate):

- Station 110+83.5
- Station 147+20
- Station 149+60

A Special Provision for Culvert Foundation Treatment is attached.

Cut Slopes

See our original 464 report and Addendum #1 for additional details.

Subgrade Treatment

See our original 464 report and Addendum #1 for additional details.

Moisture Sensitive Soils

Based on the information from the Geotechnical subsurface investigation and the District Soil Survey, moisture sensitive soils are prevalent throughout both projects. Small increases in moisture content are detrimental to the strength of these soils, possibly

resulting in construction difficulties. A Moisture Sensitive Soils Special Provision is attached.

Professional judgments and recommendations are presented in this report. They are based partly on evaluation of the technical information gathered, partly on historical reports and partly on the Geotechnical Section's general experience with subsurface conditions in the area. The Geotechnical Section does not guarantee the performance of the project in any respect other than that the engineering work and the judgment rendered meet the standards and care of the profession. It should be noted that the borings may not represent potentially unfavorable subsurface conditions between borings. If, during construction, soil conditions are encountered that vary from those discussed in this report or historical reports, or if design loads and/or configurations change, the Geotechnical Section should be notified immediately in order that it may evaluate effects, if any, on foundation performance. The recommendations presented in this report are applicable only to this specific site. These data are not to be used for other purposes.

Questions regarding this matter may be directed to Patrick McCann, MDT Geotechnical Section @ (406) 444-6277 (pmccann@mt.gov), or Scott Helm @ (406) 444-6279 (shelm@mt.gov).

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 Materials File
 Geotechnical File

Attachments: Culvert Foundation Treatment Special Provision*
 Embankment Foundation Treatment Special Provision*
 Modified Embankment Foundation Treatment Special Provision*
 Moisture Sensitive Soils Special Provision*
 Rock Fill Special Provision*
 Special Borrow Special Provision*
 Boring Logs (See original Geotechnical Report dated June 22, 2007)
 Boring Locations Strip Maps (See previous Geotechnical Report)
 Laboratory Test Summary (See previous Geotechnical Report)

*Placed electronically on DMS